Hazard Type
WINTER STORM
Probability of Occurrence
HIGH
Vulnerability
HIGH
Risk
HIGH

Chapter 4.2
Storm Hazard Profile

Introduction

Severe weather events are the most frequent source of natural disasters for Thurston County and its communities. Between 1965 and 2016, 18 of 22 Presidential Disaster Declarations involving Thurston County were attributed to damage resulting from winter storms (principally flood damage). Storms cause injury and sometimes death, and can also significantly damage property and disrupt people's lives. Between 2010 and 2015, severe storms killed 77, injured 75, and caused $430.6 billion in damages statewide in Washington[1] (43 of the deaths were caused by the 2014 Oso mudslide).

Refer to the Flood and Landslide Hazard Profiles for more information about these hazards.

2010 – 2015 Summary of Hazardous Weather Fatalities, Injuries, and Damage Costs in Washington State

Year	Fatalities	Injuries	Property Damage (millions $)	Crop Damage (millions $)	Total Damage (millions $)
2010	3	8	11	0.09	11.09
2011	6	5	18.82	0.68	19.49
2012	6	5	27.32	1.13	28.45
2013	4	16	12.84	0.5	13.33
2014	50	34	328.16	1.12	329.28
2015	8	7	28.94	0.02	28.96
Total	77	75	427.08	3.54	430.6

Advances in weather forecasting technology allow for relatively accurate predictions of pending storms and their area of impact three to five days before they occur. Advanced weather notification enables people and communities to take safety precautions. But even with warnings, communities remain vulnerable as evidenced by storm impacts that have frequently buffeted this region over the last decade.

The high recurrence rate of Pacific Northwest storms, the record of historical damage, and the repetitive response and recovery costs associated with these destructive events make the region highly vulnerable to storm events. Thus, the overall risk rating for severe storms in the Thurston Region is high.

Hazard Identification

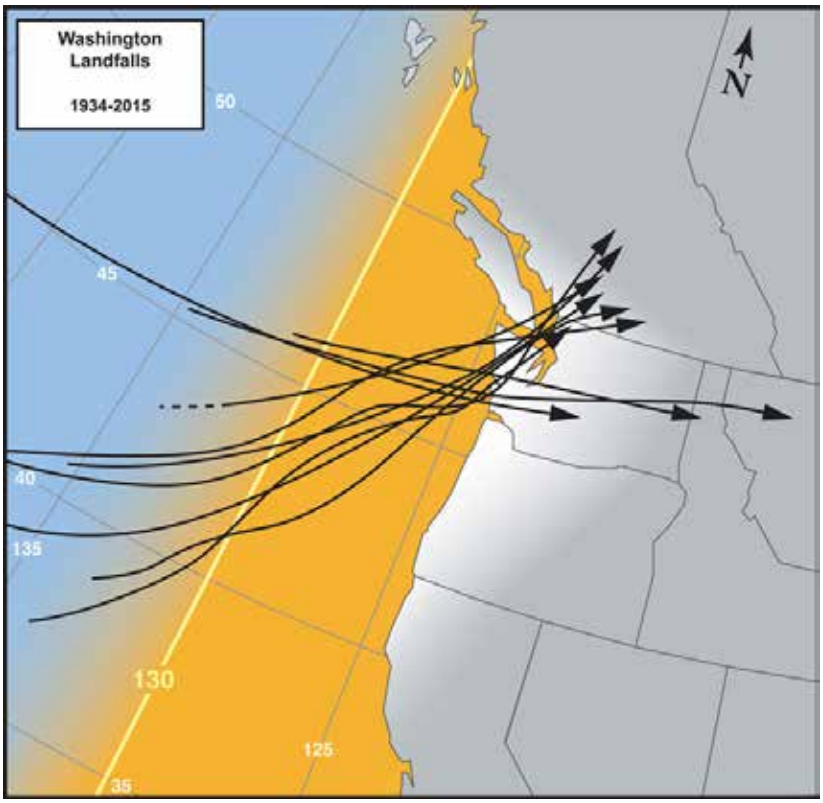
A severe storm is a meteorological event generated by atmospheric conditions. The most destructive storms in Western Washington occur from October through April delivering sustained high speed directional winds and higher than normal levels of precipitation. These storms cause significant property damage, power loss, and disruption to services across all sectors of communities. High winds, heavy rain, heavy snow, freezing rain, tornados, hail, and lightning all impact the Thurston Region. Each element poses a threat and is included in this hazard profile. Winter storms that affect Thurston County usually pack more than one hazardous element at a time or deliver elements in consecutive blows such as a snow storm followed by heavy rain and a windstorm. This section defines each element, its severity, its impacts, and its probability of occurrence.

1. High Winds/Windstorms

Definition

The National Weather Service defines high winds as "sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration."[2] Generally, winds above 30 mph can cause widespread damage and those above 50 mph can lead to more serious disasters. Most large windstorms that affect the region are delivered by mid-latitude eastern Pacific cyclones. Northern Hemisphere cyclones are large-scale storms with winds that rotate counterclockwise around a central region of low atmospheric pressure. These cyclones obtain their energy from the large horizontal variation in temperature in the mid-latitudes (30° to 60° north). Mid-latitude cyclones are not as powerful as tropical hurricanes. However, they can generate wind speeds in excess of 100 mph and can maintain their strength farther inland and affect a much larger area of land.[3] The Puget Sound Region's most powerful southerly and westerly winds typically come from these storm systems when their low pressure centers move from southwest to northeast and cross the coast between the northern tip of the Olympic Peninsula and central Vancouver Island. Other landfall trajectories from northern Oregon to the central Washington coast are also capable of causing wide spread destruction in Thurston County.

Trajectories of Washington's Strongest Storms[4]



Severity

The coastal mountains afford Thurston County some protection from severe southerly and westerly winds, buffering and shielding the region from extreme winds in excess of 80 mph. Thurston County does not experience the 100 mph or greater winds that sometimes wreak havoc on Washington's Pacific Coast communities. Nevertheless, the entire county is directly or indirectly susceptible to the effects of high speed winds. Neighborhoods with isolated, non-wind firm stands of tall evergreen trees or deciduous trees with leaf-laden canopies in the early fall are the most susceptible to blowing over and causing damage to surrounding property. All communities can suffer extended power outages.

The average wind speed at the Olympia Airport, as recorded over a 68-year period, is six mph. Between 1948 and 2016, 117 unique windstorm events with hourly wind speeds over 30 mph and 14 windstorm events with wind speeds over 40 mph have buffeted Thurston County.[5] The most powerful windstorm in the last 100 years occurred on Columbus Day, October 12, 1962. This storm tracked northeast along the Washington coast and produced record peak wind gusts of 78 mph at the Olympia Airport. The Beaufort Scale (on the next page) provides a reference for observable effects relative to wind speed.

Beaufort Scale

Beaufort Scale	Wind Speed mph	Description	Land conditions
0	<1	Calm	Calm. Smoke rises vertically.
1	1 to 3	Light air	Wind motion visible in smoke.
2	3 to 7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8 to 12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-17	Moderate breeze	Dust and loose paper raised. Small branches begin to move.
5	18-24	Fresh breeze	Branches of a moderate size move. Small trees begin to sway.
6	25-30	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.
7	31-38	High wind, Moderate Gale, Near Gale	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	39-46	Fresh Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Strong Gale	Larger branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	55-63	Whole Gale/ Storm	Trees are broken off or uprooted, saplings bent and deformed, poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	64-72	Violent storm	Widespread vegetation damage. More damage to most roofing surfaces, asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	≥73	Hurricane-force	Considerable and widespread damage to vegetation, a few windows broken, structural damage to mobile homes and poorly constructed sheds and barns. Debris may be hurled about.

Impacts

The Thurston Region, like most of Western Washington, is vulnerable to high winds because of the climatic conditions and the prevalence of non-wind firm tall mature coniferous trees surrounding developed properties and infrastructure. High winds weaken standing trees and structures that are weighted with snow or ice. Douglas fir and Western hemlock have shallow lateral root systems with top heavy crowns. Regular autumn rains saturate soils and decrease tree root adherence to soils. Sustained high winds and gusts cause trees to sway significantly. Repetitive swaying motion can eventually weaken a tree's hold and force it to topple. Tall columnar trees and their massive branches act like giant hatchets and sever electrical transmission lines, crush vehicles, damage homes and buildings, and block transportation routes. Falling tree limbs and other flying debris can injure or cause the death of people and animals. Downed power lines have caused electrocutions elsewhere in the greater Puget Sound Region.

Widespread power outages can take several days to restore. The total mass of downed debris on the transportation network impedes the response of emergency personnel and utility crews. Electrical blackouts force the closure of government offices, businesses, and schools. Power outages can disrupt transportation, generating traffic snarls resulting in thousands of motorists seeking few available alternate routes on local arterials and collectors, complicated by blocked roads. When power outages occur simultaneously with heavy stormwater flows, public works crews may struggle to provide auxiliary power to sewer lift stations to prevent backups or flooding in suburban and urbanized areas.

People without power may lack backup home heating systems, and risk hypothermia if temperatures persist below freezing levels. Out of desperation, some people may resort to heating their homes with BBQ grills, unaware of the risks of carbon monoxide poisoning. The potential for home fires increases county-wide as people use candles for lighting or start wood fires in stoves or fireplaces that are structurally faulty or have excessively dirty or blocked chimneys. Individuals with home-powered life support systems, such as oxygen respirators or suction equipment, may be at risk of health complications without backup power systems. Low income populations are particularly impacted by loss of food due to spoilage from lack of refrigeration.

Between 1960 and December 2015, windstorms impacting Thurston County resulted in combined adjusted property damages of more than $36.8 million dollars (adjusted to 2016-dollar value).[6]

Probability of Occurrence

The 2013 Washington State Enhanced Natural Hazards Mitigation Plan identifies Thurston County and 29 other counties as susceptible to high winds. These counties have an annual high wind recurrence rate of 100 percent. Numerous extratropical cyclones have impacted the Pacific Northwest and the Thurston Region in the last 25 years, thus probability of occurrence is high.

2. Heavy Rain

Definition

The quantity of rainfall that constitutes heavy conditions varies by location and season. In general, heavy rainfall is any amount of rain produced in a relatively short time period that exceeds the capacity of natural systems' or stormwater infrastructures' ability to effectively and safely convey the flow of stormwater. Excess water flows and accumulations can lead to hazardous conditions such as flooding and erosion. Excess rainfall can saturate soils on steep slopes which make them susceptible to mudslides or landslides. (See Flood Hazard Profile for more information on precipitation patterns related to flooding).

Severity

Prolonged heavy rains directly or indirectly affect the entire region and typically occur from November through February. Properties at greater risk include those in flood plains, with high ground water, with stormwater drainage problems, or those closely adjacent to steep slopes. The region overall is moderately vulnerable to flood.

Photo courtesy of The Olympian

Impact

The most common impacts from heavy rainfall are flooding and erosion. Prolonged rain delivered by weather systems north of the Hawaiian Islands dubbed atmospheric rivers, can rapidly melt snow in the Cascade Mountains and lowlands. This precipitation can cause: rivers to rise quickly; flooding downstream in valleys; and widespread landslides both in the uplands and the lowlands. Local rainfall also swells local creeks and streams, exacerbating local flood potential. Refer to the Flood and Landslide Hazard Profiles for more information on these impacts.

Probability of Occurrence

Considering that 19 of 22 federal disaster declarations, for the period of 1965 to 2012, resulted from major flooding, damaging heavy rain has a 38 percent annual probability of occurrence. Damaging heavy rains have a high probability of occurring.

3. Freezing Rain

Description

Freezing rain occurs when rain descends through a cold air mass, cools, and then subsequently freezes on contact with cold surfaces. An ice coat will continue to accumulate on surfaces as long as conditions exist. Ice can accumulate to thicknesses greater than one inch.

Severity

The entire county is susceptible to the effects of an ice storm of the magnitude experienced on December 26, 1996. This storm resulted in ice accumulations of one-quarter to three-quarters of an inch. The December 2008 winter storm delivered freezing rain, but accumulations of ice were less than one-tenth of an inch. Ice can accumulate on nearly every surface including tree branches, power lines, roof tops, motor vehicles, streets, sidewalks, and traffic signals and signs. Transportation networks are especially vulnerable to freezing rain as it coats nearly every exposed paved surface.

Impacts

The weight of thick ice accumulations can stress structures, causing trees tops and branches and power lines to snap. Downed live power lines

Photo courtesy of Komo News

can ignite fires. Dangerous driving conditions and power outages almost guarantee the closure of government offices, businesses, and schools. Despite the issuance of alerts to avoid travel, the demand for emergency assistance to respond to traffic accidents can quickly overwhelm the capacity of local fire and law enforcement personnel.

Probability of Occurrence

Although trace freezing rain events occasionally occur, the December 26, 1996 event was the most damaging Pacific Northwest ice storm in the last 50 years. The scarcity of an event of this magnitude suggests that the annual recurrence rate may be one to two percent or occur every 50 to 100 years. Therefore, the probability of a major destructive freezing rain event in the next 25 years is low.

4. Heavy Snow

Definition

The Washington State Hazard Mitigation Plan defines heavy snow as four inches of snowfall in 12 hours or six inches in 24 hours for non-mountainous areas. This amount is sufficient to disrupt activities in Thurston County. In general, heavy snow is any amount of snowfall that exceeds the ability of communities to maintain relatively normal levels of public and private sector services.

Falling snow mixed with high winds produces a blizzard. According to the National Weather Service, a blizzard occurs with the following conditions." [Three hours or more of] sustained wind or frequent gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than ¼ mile)."

Severity

Heavy snowfall affects all of Thurston County. Snowfall in the Puget Sound lowlands typically occurs from mid-November through early March, with most accumulations occurring from December through February. Light snow, less than four inches deep, can temporarily disrupt normal traffic operations on roads and streets until public works departments clear priority routes. In general, snow hazards and road clearing abilities become more problematic with decreasing temperatures, increasing snow depth, and length of time that snow remains on the ground. Even when priority routes are clear, numerous neighborhood streets and local collectors can remain impassable for many motorists when snow depths exceed one foot.

The average annual snowfall for Thurston County is approximately 17 inches (average maximum of all weather stations in Thurston County, 1948-2015). Most periods of snow fall generally do not exceed six inches within a 24-hour period. However, weather station records indicate that such snowfalls have occurred 39 times in Thurston County since 1948. Between December 1968 and January 1969, 81.5 inches of snow fell, resulting in snow depths likely exceeding the 24 inches recorded at the Olympia Regional Airport weather station. Snow remained at one-half to one-foot deep through the first two weeks of February. Larger snowfall accumulation typically occurs at higher elevations and distances further away from the Puget Sound.

Total days with 12 inches or greater of snow on the ground in Thurston County, 1948 to 2015

Year	12-inch snow days
1950	7
1954	4
1969	7
1972	8
1980	3
2008	10
2012	4

Impacts

Heavy snowfall and blizzard like conditions drastically reduce motorists' visibility, especially in the dark, increasing the risk for motor vehicle accidents. Heavy snow affects all modes of transportation. Snow, even in windless conditions, presents serious hazards. Icy road conditions are a major cause of vehicle accidents resulting in property damage, traumatic injuries, and fatalities. Significant snowfall can disrupt surface transportation networks for several days and overwhelm the snow removal capabilities of public works departments, delay public transit services, as well as delay response times of emergency responders. Delayed freight distribution can also occur, with possible shortages of goods such as fuel. Deep snow and sustained freezing temperatures can force the suspension or closure of both public and private sector services for several days. Excessive snow loads on structures can cause roofs and utility lines to collapse. Structural collapses are more likely when snow loads gain additional weight

from subsequent absorption of rain. Flat roofs, sheds, carports, and awnings are vulnerable to collapse from excessive snow loads. During the melting period, snow can block storm drains and cause localized flooding.

Probability of Occurrence

Between 1948 and 2015, weather stations in Thurston County recorded 39 daily snowfall events with depths of six inches or greater. The annual recurrence rate for at least one day with a total accumulation of 12 inches or greater in a year is 67 percent or about every 8.9 years on average. The probability of a snow storm in Thurston County is high.

5. Tornado

Definition

The National Weather Service defines a tornado as "a violently rotating column of air, usually pendant to a cumulonimbus [cloud], with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena." Tornadoes are the most unpredictable weather phenomena.

Severity

The extent and severity of a tornado depends on its location, the length of touchdown time, and the strength or wind speed of the tornado event. The Fujita scale classifies tornados according to their wind speed (see next page). In Western Washington, tornados have occurred during March, April, May, June, August, September, October, November, and December. A total of 94 tornados have been documented in Washington State between 1950 and 2005.[7] Of these, 46 were F0, 29 were F1, 12 were F2, and three were F3. Damaging tornados are rare in Thurston County, and none have adversely affected densely populated areas. Damage from historic events was isolated to small areas. Storm records suggest that a tornado could potentially touch down anywhere in the lowlands of the county, but would not likely exceed a Fujita scale 1 (F1). Between 1950 and 2008, four small tornados (three F0, and one F1) occurred in Thurston County near Bucoda, Tenino, Yelm, and Lacey in 1994, 2003, 2004, and 2006 respectively.[8]

No deaths or serious injuries resulting from tornados have occurred in the county. It is interesting to note that during the 58-year period of recorded observations, three of the tornados occurred within a three-year period. Although tornados are rare in Thurston County, disastrous tornados have occurred elsewhere in Western Washington. On April 5, 1972, an F3 tornado (wind speed 158-206 mph) touched down in Portland, Oregon and created a nine-mile path of destruction north to Vancouver, Washington. In Vancouver, the tornado ripped through a grocery store, a bowling alley, a shopping mall, and an elementary school. It caused six deaths, 300 injuries, and nearly $50 million in damages.[9]

The Fujita Scale

F-Scale	Wind Strength	Description of Damage
F0	40-72 mph	**Minimal Damage** – Some damage to chimneys, TV antennas, roof shingles and windows. Breaks branches off trees, pushes over shallow-rooted trees, damages sign boards.
F1	73-112 mph	**Moderate Damage** – Automobiles overturned, carports destroyed, trees uprooted, peels surface off roofs, mobile homes pushed off foundations or overturned, moving autos pushed off the roads.
F2	113-157 mph	**Major Damage** – Roofs torn off frame homes, sheds and outbuildings are demolished, mobile homes overturned or destroyed, boxcars pushed over; large trees snapped or uprooted, light object missiles generated.
F3	158-206 mph	**Severe Damage** – Exterior walls and roofs blown off well-built houses, metal buildings collapsed or are severely damaged, trains overturned, forests and farmland flattened, heavy cars lifted off the ground and thrown.
F4	207-260 mph	**Devastating Damage** – Few walls, if any, standing in well-built houses, structures with weak foundations blown off some distance, large steel and concrete missiles thrown far distances, cars thrown.
F5	261-318 mph	**Incredible Damage** – Homes leveled with all debris removed, strong frame houses lifted off foundations and carried considerable distances to disintegrate. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone, steel reinforced concrete structures badly damaged. Automobile sized missiles fly through the air in excess of 100 meters, trees debarked.

Impacts

High speed rotating winds can rip apart buildings, fences, street signs, and vegetation. The tornado and the circulating winds in its vicinity can hurl objects and debris several hundred feet away from the source of destruction. Flying objects can injure or kill people and animals.

Probability of Occurrence

Based on little published data available from the National Climate Data Center, the probability of a tornado occurring in Thurston County is low.

6. Hail

Description

Hail is precipitation that takes the form of ice balls or clusters of ice clumps, ranging from two-tenths of an inch to several inches in diameter. Hail forms in cumulonimbus or thunderstorm clouds that have strong updrafts.

Severity

Most hail storms in Thurston County produce small non-destructive hail. The records of damaging hail storms are scant and suggest limited damage from these events with only small geographical areas likely affected. Although it is possible that a hail storm could unleash destruction to any portion of the county, the extent of the damage would likely be limited.

Impacts

Hail poses the greatest risk during its descent. Large hailstones can cause serious injury by striking people and animals and damage structures and vehicles. Hail storms may damage crops, but the extent or cost estimates of any past agriculture related damage within Thurston County is unknown. While little is known about a hail storm on April 8, 1992, it is estimated to have caused $8,447 in property damage (adjusted for 2016-dollars). [10]

Probability of Occurrence

Damaging hail storms are rare in Thurston County. Based on the historical information available, a hail storm producing hail greater than 0.75 inches in diameter has a five percent annual recurrence rate. The probability of a damaging hail event is low.

7. Lightning

Description

Lightning is an atmospheric discharge of electricity that typically occurs with thunderstorms. A lightning bolt can travel at 60,000 meters per second and reach temperatures of 54,000° F.

Severity

Lightning storms in Thurston County are short lived and generally only affect a small area. However, the entire county is potentially vulnerable to lightning strikes. Historically, lightning has not caused widespread damage nor posed a serious threat to the region.

Records indicate that lighting storms in Thurston County are most likely to occur from April through September. This time coincides with the dry season, so it is conceivable that a larger than normal wildfire could result from lightning strikes over forestlands in Thurston County.

Impacts

There are no documented lightning fatalities in Thurston County. Multiple lightning events have resulted in some injuries and damage in various locations. Lightning can strike people causing burn injuries, paralysis, or even death. It can also start fires, split trees, and disrupt power transmission. Since 1960, at least 11 lightning storms have caused $207,808 in property damage in Thurston County (adjusted for 2016-dollars). Since 1972, lightning ignited at least 28 wildland fires. A total of 28 acres are known to have burned. The largest fire burned 15 acres on private timberland in a remote area of southeast Thurston County in June 2004.[11] Damage estimates for these fires are unknown. History suggests the probability of a lightning event causing damage or injury is low.

Probability of Occurrence

The likelihood of lightning storms is high. However, the overall risk of a destructive lightning storms is low.

Effects of Climate Change on Storms

Research and climate forecasts offer evidence that long-term climate change will have a measurable impact on the frequency and intensity of storms. The University of Washington Climate Impacts Group published a detailed report on the state of science on climate change and its effects within the region titled, "State of Knowledge: Climate Change in the Puget Sound." The report identifies several factors that will influence storms for the Pacific Northwest and Puget Sound.

Air temperatures are increasing in the Puget Sound Region. They are projected to warm rapidly during the 21st century. By mid-century, warming will be outside of the range of historical variations. Warming is projected for all seasons, but will be greatest for summer. As a result of warmer winters, watersheds will become increasingly rain dominant and streamflow is projected to peak earlier in winter and decrease in spring and summer. Winter streamflow is projected to increase by 28 to 34 percent on average by the 2080s.

Overall annual precipitation levels are forecast to remain the same, but there will be greater seasonal variation. Summers will become drier and winters will be wetter. The frequency of the region's peak 24-hour rain events is expected to more than triple by the end of the 21st century. Such heavy storms are also expected to become more intense, with greater rainfall occurring in shorter periods of time. For the Thurston County planning area, such changes in precipitation patterns will impact flood and landslide conditions. Climate change models are not forecasting significant variation for the nature and type of windstorms that are presently common in the region.

Storm Historical Occurrences and Impacts

Several notable storms have impacted the Thurston County region over the last few decades. Highlighting the effects and damages of these storms emphasizes the severity, cost, and vulnerabilities associated with these events. Estimates of potential dollar losses for future storm events were not calculated as part of this hazard profile. At present, historic storm events offer the best indication of the type and extent of future losses that local communities are likely to experience.

January 14-23, 2012, Federal Disaster 4056: Severe Winter Storm, Flooding, Landslides, and Mudslides

A series of winter storms dubbed "Snowmaggedon" hit Western Washington in mid-January. An upper level trough and Arctic air pushed into Western Washington and combined to produce widespread heavy lowland snow. Several bands of snow showers fell from January 14 through 18. Multiple weather stations in Thurston County recorded

snow depths of 12 or more inches. Portions of the Alpine Hills subdivision near Black Lake received nearly 30 inches.

Roads and transportation systems were severely disrupted from snow and fallen branches and trees. Residents calling and requesting to have their roads cleared overwhelmed public works agencies. Crews worked rotating 12-hour shifts through the week to plow arterials and collectors. Sixteen of 24 Intercity Transit bus routes were running on detour routes, and service to the west side of Olympia was temporarily cancelled. The Washington State Patrol reported handling 205 collisions in Thurston and Pierce counties in a 14-hour period.[12] Thurston County Medic One added an additional paramedic unit to both Yelm and the Grand Mound Rochester areas to respond to 9-1-1 call demands and compensate for increased travel times resulting from icy road conditions.

Schools and most local government offices were closed, including the county courthouse in Olympia. Multiple emergency and warming shelters were opened around the county. The Salvation Army reported that their downtown Olympia shelters were full with homeless people escaping the winter storm. Toppled trees pulled down powerlines and some neighborhoods reported not having access to water. However, Puget Sound Energy reported no significant wide-spread power outages in Thurston County.

On February 21, 2012, Governor Christine Gregoire requested a major disaster declaration due to a severe winter storm, flooding, landslides, and mudslides during the period of January 14-23, 2012. The Governor requested a declaration for Public Assistance for 11 counties and Hazard Mitigation statewide. During the period of February 6-10, 2012, joint federal, state, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested counties. Thurston County's per capita impact was $13. On March 5, 2012, President Obama declared a major disaster in the state of Washington.

December 12-27, 2008, Federal Disaster 1825: Severe Winter Storm[13]

Near record snowfalls, freezing rain, and rain combined with sustained subfreezing temperatures froze the Thurston Region for a period of nearly two weeks making it one of the worst snow-laden winter storms in decades. Successive snowfall over the first week resulted in 18 to 20 inch depths in the Lacey, Olympia, and Tumwater area. Depths of 36 inches were reported by some county residents at higher elevations. Governor Gregoire declared a state of emergency on December 24. On March 2, a Presidential Disaster Declaration was declared for 27 counties, including Thurston County.

Public works crews struggled to keep roads free of daily snow accumulations, resulting in slick roads with deep icy ruts on many road segments throughout the cities and county. Most neighborhood streets never saw a snow plow, making vehicular travel and outings near-impossible for many of the county's residents. Blizzard like conditions on Interstate 5 caused about 20 collisions in one hour alone, including a pile up involving three tractor trailers and six cars that closed the interstate near Littlerock Road. By December 18, the Washington State Patrol responded to 54 collisions and assisted 45 drivers with disabled vehicles in Thurston County.

Over 7,000 residents and businesses lost power. Area shelters operated above capacity to care for the region's homeless population. On December 26, fire officials evacuated about 65 seniors from a wing of the Olympics West Retirement Inn in Tumwater due to unstable roof conditions stressed by excessive snow load.

Area schools closed three days prior to Christmas break. Thurston County closed its offices on December 18 and 22. Other local governments and colleges also closed their offices entirely or opened late or closed early due to road conditions.

On December 25, a 2,500 square foot section of Capital High School's roof, on Olympia's west side, collapsed from the strain of the snow load. Overhead fire sprinklers activated and caused water damage to parts of the school's interior, including the library. A natural gas pipe rupture contributed to a week delay of the school's reopening after Christmas break. Preliminary damage assessment estimates for the damage to public facilities, response costs, and snow removal costs exceeded $500,000 for all local agencies region wide (excluding Capitol High School). Private sector structural damage estimates exceeded $430,000 and personal damage was estimated around $114,000.

December 1-7, 2007 Federal Disaster 1734: Severe Winter Storm, Landslides, and Flooding

Snow followed by heavy rain and winds caused record flooding on the Chehalis River. The Deschutes and Black rivers rose above their banks. Communities experienced stream and urban flooding. Flash flood conditions in the Capital Hills and Capital Forest resulted in washouts, landslides, and urban flooding on major intersections in Olympia's west side. See flood and landslide hazard profiles for more details on this event.

October 18, 2007 Windstorm

The Olympian reported that wind gusts of 44 mph knocked down trees and power lines across Thurston County causing scattered power outages in mostly rural areas. The City of Olympia closed its parks as an emergency measure. A power line fell on an Olympia School District bus en route to pick up students; the driver was not injured.

January 5, 2007 Windstorm

Sustained winds of 22 mph and a peak gust of 40 mph toppled trees and disrupted power for about 9,500 households in Thurston County.

December 14-15, 2006 "The Hanukkah Eve Storm" Federal Disaster 1682: Severe Winter Storm, Landslides, and Mudslides

The December 14-15 storm included snow, rain, and high winds. The windstorm may have produced the most damaging winds to hit the Pacific Northwest since the Columbus Day

Storm of October 12, 1962. The Hanukkah eve storm achieved sustained winds of 36 mph and gusts of 53 mph as recorded at the Olympia Airport weather station before it lost power. KGY Radio, located on Budd Inlet, reported a wind gust of 78 mph at 12:30 a.m. on the 15th. Wind gusts exceeded 100 mph along parts of the Oregon coast. November rains saturated area soils resulting in significant fallen trees and broken limbs. Strong winds knocked down 85 of Puget Sound Energy's 208 high-voltage transmission lines and 159 of 358 neighborhood substations. 700,000 PSE customers lost power. An estimated 1.5 million customers of all northwest utilities combined lost power. In Washington, the storm claimed at least 13 lives. The Thurston Region experienced the following impacts and losses:

- 9-1-1 received over 5,000 calls on the evening of December 14.
- In the City of Olympia, 13 residences were red-tagged and six were yellow-tagged.
- Over 80,000 homes, businesses, and critical facilities lost power in Thurston County. Some households were without power for over one week.
- In the urban corridor, entire phone switches went down and the phone service's central offices were either not operational or on battery backup.
- On December 16, the county documented over 70 closed roads. Many more went undocumented.
- The power outage affected gasoline, water, sewage, and solid waste disposal facilities. City water and sewage pump stations relied on generators or other means of backup power. Critical environmental instrumentation at the County Waste and Recovery Center operated on backup power.
- Some cable television customers lost service for nearly a week, disrupting a vital news source and internet access.
- Heavy rains produced flooding on the Chehalis, Deschutes, and Skookumchuck rivers. It also caused flooding from storm water runoff. This resulted in additional road closures and damage to county and private roads and bridges.
- Five Thurston County residents were transported for specialized medical care because of carbon monoxide poisoning; at least one died.
- Downed trees caused multiple vehicle accidents including two fatalities from two separate incidents.
- The storm cost Thurston County $456,000 in response and recovery costs.
- Countywide, a total of $898,000 in damages to local government buildings, facilities, and parks was reported to Thurston County Emergency Management.

November 2-11, 2006 Federal Disaster 1671: Severe Winter Storm, Flooding, Landslides, and Mudslides

On November 6, 3.4 inches of rain fell; a 24-hour rainfall record for that day of the year. The heavy rains caused flooding of urban roads and streets throughout the Thurston Region. Preliminary damage assessments for personal and business property damage exceeded $300,000.

May 27, 2004 F1 Tornado

An F1 tornado touched down four miles southwest of Tenino tearing a metal roof off a barn, splintering the building timbers, breaking windows in an adjacent building, and snapping a 12-inch diameter ponderosa pine tree into two. Debris was strewn in an area 200 yards wide by a quarter mile long. The damages estimate was $50,000 to $75,000.[14]

January 6, 2004 Snow Storm

Six to nine inches of snow fell around Thurston County. Area schools and some businesses closed for up to three days.

May 17, 2003 Lightning Strike

A Thurston County woman was temporarily partially paralyzed when lightning struck a nearby tree outside her mobile home.[15]

October 15-23, 2003 Federal Disaster 1499: Severe Storms and Flooding

Thurston County was included in this federal disaster declaration, but storm damage to Thurston County was negligible.

June 17, 2002 Lightning Strike

A 17-year old boy was struck by lightning while he was working outside in Lacey. He sustained minor burns, some hearing loss and a headache. The tree next to him was stripped of its bark.[16]

September 5, 2002 Lightning Strike

Lightning struck a garage in Lacey, a state-owned building, and a tree in the Olympia area. The garage, filled with antiques, was destroyed. The state-owned building lost power and the tree was split.[17]

December/January 1996/1997 Federal Disaster 1159, Ice, Wind, Snow, Landslides, and Flooding

Snow, ice, and freezing rain crippled Thurston County on December 26. This storm produced the worst freezing rain event to hit the south Puget Sound Region in decades. Due to snapped power lines and downed trees, 53,000 electric customers lost power. Downed power lines ignited four tree fires in the Tumwater Hill neighborhood. Sub-freezing temperatures and power outages persisted for over a week into early January. A family of four suffered carbon monoxide poisoning after using a BBQ grill to heat their home. County-wide, local governments reported $3.14 million in damage and cleanup costs. Residents reported $980,000 in uninsured damages.

September 1, 1997 Hail Storm

Golf ball sized hail was reported near Yelm, which broke several car windshields. No estimate of damages is available from this event.[18]

December 12, 1995 Windstorm

A windstorm caused widespread destruction from northern California to British Columbia. Wind gusts of 57 mph rattled the Thurston Region causing widespread power outages to nearly 45,000 households and businesses. Road closures from fallen trees and limbs forced the closure of many local and state government offices and area businesses. One Mason County woman was killed when a power transformer exploded near her home, setting her residence on fire. First responders could not reach her home due to road blocks.

April 6, 1994 F0 Tornado

An F0 tornado touched down near the main street of Bucoda. Several buildings sustained damage, including aluminum sheds blown over or moved, rain gutters torn off buildings, and a twisted street sign. A piece of one aluminum shed was seen 80 feet above the ground caught in a tree. The total damage from this event was estimated at $50,000.[19]

January 20, 1993 Inaugural Day Windstorm, Federal Disaster 981, Windstorm

One of the most powerful windstorms to hit Western Washington since the 1962 Columbus Day Storm, caused nearly $130 million in damages, resulted in five deaths, and destroyed 52 residential units statewide. Winds reached gusts of 55 mph at the Olympia Airport weather station.

The Thurston County region suffered near blackout conditions, only a few neighborhoods around the City of Tenino retained their power. The power outage forced the LOTT Wastewater Treatment Plant in Olympia to discharge nearly 1.3 million gallons of barely treated wastewater into Budd Inlet. Customers flooded local area stores for provisions – creating shortages in batteries, candles, and bottled water. The Hawks Prairie BP gas station was one of only two operational stations in the county and hundreds of people lined up for hours to fuel their vehicles. Lacey Police were called in to control the crowd; no arrests were made.[20]

August 27, 1983 Hail Storm

Two hail storms occurred 30 minutes apart on one evening in Thurston County. Both events reported three quarter inch size hail. No estimate of damage is known for this event.[21]

November 14-15, 1981 Windstorms

Two back-to-back windstorms brought winds with peak gusts of 64 mph to the region over a two-day period resulting in power outages for 60,000 households and businesses in the county. Nearly 150 boats broke loose from marinas in Budd Inlet. An estimated $3.4 million was reported in private property damages.

Storm Hazard Exposure Analysis

Severe storms affect every jurisdiction in the county. As a result, storm hazard exposure tables were not developed. The “total” columns in the population, employment, and assets tables provided for the other hazards provide useful information in assessing the population and assets at risk from a countywide hazard.

Essential Facilities and Infrastructure in Hazard Area

Based on the historical occurrence of natural hazards causing community impacts, severe storms can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations, electrical generating and transmission facilities, water storage, purification, and pumping facilities, sewage treatment facilities, hospitals and health care clinics, and police stations. In addition, natural hazards can seriously disrupt the transportation network, bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

All essential facilities in Thurston County are located within the storm hazard area. Specific information on the location and type of facilities is maintained by Thurston County Emergency Management. Essential facilities include both public and private facilities. Table 4.2.1 lists the type and number of essential facilities located in the storm hazard area.

Summary Assessment

The probability of each storm element's occurrence varies, but winter storms frequently pack several hazardous elements across a period of consecutive days or weeks, therefore the overall probability of winter storm occurrence is high. The overall impacts described in both the hazard profile and the brief record of historical occurrences demonstrates that the region's vulnerability is also high. Therefore, the overall risk rating for severe winter storms is high.

Thunderstorms do occur in Thurston County, but the probability of occurrence of this storm element is low. Even thunderstorms that produce a combination of the listed elements rarely cause destruction beyond isolated areas. Therefore, the overall probability of occurrence, the vulnerability rating, and the overall risk for thunderstorms are all low.

Summary Risk Assessment for Winter Storms and Thunderstorms in the Thurston Region

Storm Type	Storm Hazard Element	Probability of Occurrence	Vulnerability	Risk
Winter Storm	High Winds	High	High	High
	Heavy Rain	High	Moderate	High
	Freezing Rain	Low	High	Moderate
	Heavy Snow	High	Moderate	Moderate
Overall	**Assessment**	**High**	**High**	**High**
Thunder Storm	Tornado	Low	Low	Low
	Hail	Low	Low	Low
	Lightning	High	Low	Low
Overall	**Assessment**	**Low**	**Low**	**Low**

Table 4.2.1 Essential Facilities in the Storm Hazard Area

Facility Type	TOTAL #	IN HAZARD AREA #	IN HAZARD AREA %
Medical Care			
Adult Family Home	124	124	100.0
Assisted Living	14	14	100.0
Dentist	110	110	100.0
Dialysis Center	3	3	100.0
Funeral Home	6	6	100.0
Hospital	2	2	100.0
Nursing Home	7	7	100.0
Pharmacy	42	42	100.0
Primary Care	91	91	100.0
Urgent Care	6	6	100.0
Government			
Court Services	3	3	100.0
Cultural Significance	2	2	100.0
Detention/Corrections	1	1	100.0
Fairgrounds	35	35	100.0
Fire Service	53	53	100.0
Government Services	56	56	100.0
Health and Human Services	2	2	100.0
Law and Justice	4	4	100.0
Law Enforcement	8	8	100.0
Port Facilities	35	35	100.0
Public Education	344	344	100.0
Public Higher Education	52	52	100.0
Public Works	33	33	100.0
Solid Waste	20	20	100.0
Transit	4	4	100.0
Utilities	238	238	100.0
Transportation (Centerline Miles)			
Roads	2,210	2,210	100.0
Intercity Transit Routes	157	157	100.0
Rural Transit Routes	96	96	100.0

Endnotes

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